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Title: Image Display Panel and Driving Method Thereof

(57)[Abstract]

[Object] To develop an image display panel capable of presenting a high resolution image to be used for displaying images on the display of a computer or a television, it is necessary to contract the size of each display cell which makes it difficult to activate the display and fabricate the same.

[Solving Means] Triads of red cell, blue cell and green cell each constituting a pixel are arranged side by side in parallel with the row direction such that the area of each pixel is two times as large as that of each signal pixel to be displayed. A frame is further divided into two fields: one field comprises odd-numbered row lines and the other field comprises even-numbered row lines. Combination of display cells (red, blue, green) within each pixel is allowed to change between the two fields such that a shift is intervened between a pixel of the first field and a corresponding pixel of the second field that is equal to the pitch of a corresponding display signal pixel.

[Claims]

[Claim 1] A method for activating an image display panel in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the row direction or the columnar direction, wherein the period for displaying an image is divided in two sub-periods, one is a sub-period during which an image is displayed by a first arrangement of pixels comprising the triads of blue, red and green display cells arranged side by side in one direction, and the other is a sub-period during which an image is displayed by a second arrangement of pixels where combination of blue, red and green display cells within each pixel is different from the one observed for the pixels of the first arrangement, the pixels being arranged side by side in the above direction.

[Claim 2] The method according to Claim 1 for activating an image display panel wherein the image displayed by the first arrangement of pixels is represented by odd-numbered row lines while the image displayed by the second arrangement of pixels is represented by the even-numbered row lines.

[Claim 3] The method according to Claim 1 for activating an image display panel wherein the image displayed by the first arrangement of pixels is represented by odd-numbered columnar lines while the image displayed by the second arrangement of pixels is represented by the even-numbered columnar lines.

[Claim 4] An image display panel activated by a method according to any one of Claims 1 to 3 wherein the summed area of the blue, red and green display cells of each pixel arranged side by side in one direction is equal to the summed area of two pixels to be displayed to form an image.

[Claim 5] An image displaying device in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the row direction, comprising an image display panel as described in Claim 4 wherein for each pixel, its parallel-to-row length is two times as large as its parallel-to-column length.

[Claim 6] An image displaying device in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the columnar direction, comprising an image display panel as described in Claim 4 or 5 wherein for each pixel, its parallel-to-column length is two times as large as its parallel-to-row length.

[Claim 7] The image display panel according to any one of Claims 4 to 6 wherein, for the blue, red, and green display cells within each pixel, the area of one display cell is equal to the summed area of the remaining two display cells.

[Claim 8] The image display panel according to any one of Claims 4 to 7, comprising plasma display panel wherein a first substrate and a second substrate are placed opposite to each other with a discharge space inserted therebetween, and a voltage is applied to allow discharge to occur

through a discharge gas entrapped within the discharge space thereby generating ultraviolet light which excites a phosphor layer formed facing toward the discharged space so that visible light is obtained.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention] The present invention relates to an image display panel including a plasma display panel capable of displaying an image in color, and a method for activating the same.

[0002]

[Description of the Related Art] An image display panel including a plasma color display panel, liquid crystal-based color display panel or the like comprises pixels each of which has a combination of red, blue and green display cells. Fig. 7 shows exemplary arrangements of pixels: Fig. 7(a) shows a display where triads of blue cell (B), red cell (R) and green cell (G) each constituting a pixel are arranged side by side in a direction in parallel with the row direction; Fig. 7(b) shows a display where pixels are arranged such that each pixel comprises display cells extended over two rows and two columns; and Fig. 7(c) shows a display where pixels are arranged such that each pixel comprises three display cells arranged in the form of a triangle. Among the pixel arrangements of the above displays, the one shown in Fig. 7(a) is advantageous in that activation of pixels is comparatively easy since input

signals for activating the triads of blue, red and green cells on the same row can be made common for all the display cells of each pixel because of the pixels being arranged side by side on the same row line. Moreover, with this arrangement, since the same display cells are arranged one after another for any given column, it is possible to simplify the application of phosphor substances on a display substrate. Particularly, with respect to an AC type plasma display panel for which a front plate and a rear plate must be precisely aligned to each other, it is possible by adopting the pixel arrangement shown in Fig. 7(a) to simplify the procedure required for joining a front panel to a rear panel, since a substrate having phosphors coated thereon in the form of parallel stripes is allowed to have a structure for which expansion in a direction in parallel with the columnar direction can be tolerated more easily.

[0003] Recently, the resolution of image presented on a display panel has been increasingly improved. Thus, an image display panel must be able to present a highly resolved image in order to serve as a high resolution monitor of a personal computer or to be compatible with a high resolution image source working on high-vision image signals. To achieve the improved resolution of a given display panel, it is necessary to contract the size of each display cell. Then, how to activate individual cells stably and how to maintain the production margin pose another problem.

[0004]

[Problems to be Solved by the Invention] According to the arrangement of pixels shown in Fig. 7(a), since each pixel having an approximately square shape comprises a triad of blue, red, and green cells put side by side in parallel with the row direction, each display cell has a rather narrow width in the row direction which interferes with an attempt to improve the resolution of an image represented by the pixels, which poses a problem.

[0005] The problem in question will be further discussed below taking an AC type plasma display panel as an example.

[0006] A surface discharge type AC plasma display panel attracts people's attention since it allows the construction of a big rectangular display whose diagonal reaches as much as 1 m or more, and has a structure as shown in Fig. 1 where a front substrate 2 is placed opposite to a rear substrate 3 with a discharge space filled with a discharge gas inserted therebetween, the front substrate carrying scanning electrodes 4, holding electrodes 5, dielectric layer 6, and protective layer 7 while the rear substrate 3 carrying barriers 8, phosphor layer 9, second dielectric layer 10, and write electrodes 11. A voltage is applied between a scanning electrode 4 and a holding electrode 5 to allow discharge to occur through the entrapped gas thereby generating ultraviolet light which excites phosphor layer 9 so that the latter emits visible light responsible for the production of an image.

[0007] The most frequently adopted arrangement of pixels is the one shown in Fig. 7(a) where triads of blue, red, and green cells are put side by side in a direction in parallel with the row direction, and the same display cells are arranged one after another in a direction in parallel with the columnar direction, because of the easiness of fabrication of such a display panel.

[0008] With respect to a 42 type VGA plasma display panel currently commercialized, one pixel has an area of about 1 mm x 1 mm. Thus, each display cell has an area about one third that of the pixel, that is, about 1 mm x 0.3 mm. If it were required to further increase the resolution of an image represented by the display panel, it would be necessary to make the horizontal width of each display cell smaller than 0.3 mm.

[0009] The barriers 8 each inserted between adjacent display cells arranged in a direction in parallel with the row direction have a width of about 0.03 to 0.05 mm in terms of the distance measured between the summits of adjacent barriers. The summit of each barrier is not basically involved in the emission of light, that is, it acts as a "non-light emitting portion." With the increase of display cells, the number of barriers 8 is also increased which lowers the ratio of phosphor aperture sections for each raster line and thus reduces the brightness of image.

[0010] Display of an image on a plasma display panel is based on gas discharge. However, if the discharge space is

narrowed, the loss of charged or excited particles due to their adsorption to adjacent walls will be increased which will degrade the discharging efficiency. Namely, the fraction of energy converted into visible light out of the energy supplied by current passed during discharge will be reduced, which will result in the reduced brightness of image and increase of power consumption.

[0011] If an attempt is made to achieve the improved resolution of image by increasing the number of display cells, the horizontal width of each display cell will be narrowed, which makes difficult fabrication of the display panel, and the increased number of display cells will cause the increase of current, and reduction of the activation margin of current.

[0012] To solve the above problems, a method for activating a plasma display on interlaced scanning is proposed as disclosed in Japanese Patent No. 2801893 where a first field consists of odd-numbered row lines while a second field consists of even-numbered row lines, with scanning and holding electrodes 4, 5 being shared by the two fields. According to this method, since scanning and holding electrodes 4, 5 are shared by the cells activated in the first field as well as by the cells activated in the second field, it is possible to increase the resolution without increasing the number of electrodes in association. In contrast with the conventional method where, between adjacent cells arranged one after another on two adjoining row lines, there is inserted a non-light emitting zone, the

non-light emitting zone is replaced by a light emitting zone according to this newly proposed method, and thus, the resolution of image based on the latter method in the columnar direction will be increased two times as high as the corresponding resolution based on the conventional method. However, this arrangement of pixels only permits the improvement of resolution only in the columnar direction (or in terms of the number of rows), but does not improve the limited resolution imposed by insertion of a barrier 8 between adjacent cells disposed side by side in the row direction, that is, a problem inherent to a plasma display panel. With respect to a display panel where pixels are arranged as shown in Fig. 7(a), a more urgent problem is to find a method for achieving the improved resolution in the row direction. In addition, according to the method under study, when the first field is activated, even-numbered row lines remain quiescent while the second field is activated, odd-numbered row lines remain quiescent. Thus, at any given moment the effectively activated area is half the total display area, and the remaining half stays useless without contributing its ration of brightness.

[0013] The present invention is proposed with a view to offer a solution to the problems as described above, and provides a method for activating an image display panel capable of presenting a high resolution image without encroaching on the display area of each cell, and a method for displaying such a high resolution image.

[0014] The feature of this invention can be effectively

applied to any image display panels where improvement of the resolution of image is restricted by the limited size of display cells, regardless of the method by which the image display panel operates.

[0015]

[Means for Solving the Problems] To offer a solution to the above problems, the present invention provides a method for activating an image display panel in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the row direction or the columnar direction, wherein the period for displaying an image is divided in two sub-periods, one is a sub-period during which an image is displayed by a first arrangement of pixels comprising the triads of blue, red and green display cells arranged side by side in one direction, and the other is a sub-period during which an image is displayed by a second arrangement of pixels where combination of blue, red and green display cells within each pixel is different from the one observed for the pixels of the first arrangement, the pixels being arranged side by side in the above direction. The invention further provides a method for activating an image display panel wherein the image displayed by the first arrangement of pixels is represented by odd-numbered row or columnar lines while the image displayed by the second arrangement of pixels is represented by the even-numbered row or columnar lines. Through this arrangement, it is possible to increase the resolution of an image to be displayed while

preserving the area of each display cell without encroaching on the discharge efficiency, activation margin, and production margin.

[0016] To offer a solution to the above problems, the present invention provides an image display panel wherein the summed area of the blue, red and green display cells of each pixel arranged side by side in one direction is equal to the summed area of two pixels to be displayed to form an image. Particularly, the invention provides an image displaying device in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the row direction, wherein for each pixel, its parallel-to-row length is two times as large as its parallel-to-column length. Through this arrangement, it is possible to increase the resolution of an image to be displayed while preserving the area of each display cell without encroaching on the discharge efficiency, activation margin, and production margin.

[0017] The invention further provides an image displaying device in which triads of blue, red and green display cells each constituting a pixel are arranged side by side in a direction in parallel with the columnar direction, wherein for each pixel, its parallel-to-column length is two times as large as its parallel-to-row length. Through this arrangement, it is possible to increase the resolution of a display image which leads to the reproduction of a natural image while preserving the area of each display cell without encroaching on the discharge efficiency, activation

margin, and production margin.

[0018] To offer a solution to the above problems, the present invention further provides an image display panel wherein a first substrate and a second substrate are placed opposite to each other with a discharge space inserted therebetween, and a voltage is applied to allow discharge to occur through a discharge gas entrapped within the discharge space thereby generating ultraviolet light which is then converted to visible light. Through this arrangement, it is possible to increase the resolution of a display image and to achieve a big flat display of an image while preserving the area of each display cell without encroaching on the discharge efficiency, activation margin, and production margin.

[0019]

[Embodiments] The embodiments of the present invention will be described below with reference to Figs. 1 to 7.

[0020] An embodiment of the present invention will be described taking a surface discharge type AC plasma display panel as an example. As shown in Fig. 1, a plasma display panel 1 comprises a glass-made front substrate 2 and a glass-made rear substrate 3 placed opposite to each other with a gap inserted therebetween which is filled with a gas such as neon or xenon which, being exposed to discharge, generates ultraviolet light. The front substrate 2 carries, on its active surface, scanning electrodes 4 and holding electrodes 5 both in the form of bands covered with dielectric layer 6 and protective layer 7, said two kinds

of electrodes running in parallel with the row direction.

[0021] As shown in Fig. 2, the scanning electrode 4 and holding electrode 5 consist of metal bus lines 4a, 5a and transparent electrodes 4b, 5b, respectively. The metal bus lines 4a, 5a are for enhancing electro-conductivity, and the transparent electrodes 4b, 5b are for widening the area of discharge so that discharge can occur in a wider space.

[0022] The rear substrate 3 carries, on its active surface, write electrodes 11 in the form of a band covered with second dielectric layer 10, said electrodes running together in parallel with the columnar direction, that is, direction normal to the running direction of scanning electrodes 4 and holding electrodes 5. Band-like barriers 8 are provided in parallel with the write electrodes 11 such that a barrier 8 is inserted between adjacent write electrodes 11 to thereby separate each of the write electrodes and form a discharge space attached thereto. In addition, phosphor layers 9 are formed over the second dielectric layer 10 and on the lateral slopes of adjacent barriers 8.

[0023] The panel 1 is so constructed that the viewer can see an image thereon from the side of front substrate 2. When a voltage is applied between a scanning electrode 4 and a holding electrode 5, discharge occurs through discharge gas in a discharge space which causes the generation of ultraviolet light which excites phosphor layer 9 so that the latter emits visible light responsible for the production of an image.

[0024] Fig. 2 shows the display face of the plasma display panel, that is, a top view of the panel seen from the side of front substrate 2. The phosphor layers 9 are arranged in stripes running in parallel with the columnar direction so that the same phosphor layer forms a stripe running in the columnar direction. This arrangement is adopted because by so doing it becomes possible to easily form phosphor layers 9 and barriers 8, and to easily bond the front substrate 2 to the rear substrate 3. The symbols R (red), G (green), and B (blue) in the figure represent respective phosphor layers 9 for generating their assigned colors.

[0025] A triad of red (R), green (G) and blue (B) cells constituting a pixel X (hatched area in the figure) are arranged side by side in the row direction. Generally, the pixel length Wx in the row direction is preferably equal to the pixel length Hx in the columnar direction, because image signals have the same length in the row and columnar directions. The area of each display cell is one third the area of a pixel, and the width Wr, Wg, Wb of each display is one third the width of a pixel Wx. The widths Wr, Wg, Wb of display cells are not necessarily the same. Indeed, there is a proposal (for example, Japanese Unexamined Patent Application Publication No. 11-54047) of adjusting the color temperature of an image by varying the width Wr, Wg, Wb of individual display cells. If one of the three display cells (for example, Wb) is allowed to have a width larger than one third the width of a pixel, at least one of

the remaining two display cells (Wg, Wr) will have a width less than one third the width (Wx) of a pixel. Namely, if Wr, Wg and Wb have the same length, a condition will be satisfied where, of all possible combinations of Wr, Wg and Wb, a display cell having the smallest width is allowed to take the largest width permitted to it. The condition should be satisfied because the introduction of a cell whose width is smaller than the one permitted by the condition is undesirable for the reason as described below.

[0026] For the surface discharge type AC plasma display panel configured as described above, if it is required to increase the resolution of its display, it is necessary to reduce the area of each pixel by narrowing, for example, the intervals between adjacent barriers, that is, Wr, Wg and Wb. Then, loss of charged particles due to adsorption to adjacent walls will be increased which will lead to the reduction of light emission efficiency.

[0027] An exemplary method of the invention for activating an image display panel will be described with reference to Figs. 3 and 4.

[0028] As shown in Fig. 3, according to the inventive activation of an image display panel, a time period necessary for building a frame is divided into two sub-periods (one will be called a sub-period for a first field and the other a sub-period for a second field). The first field consists of odd-numbered lines constituting a display frame while the second field consists of even-numbered lines of the same frame.

[0029] Each field contains scan lines necessary for forming a desired image on display. Fig. 3 shows a method for tracing scan lines on a sub-field mode, or a representative method for activating a plasma display panel. According to this method, each field is further divided into sub-fields, and each subfield comprises an initialization period, write period, and prolonged discharge period. The display device adjusts the charge state of a discharge space during the initialization period, selects cells to be activated during the write period, and maintains the emission of light during the prolonged discharge period. The device adjusts the brightness of a line by varying the length of prolonged discharge period. Thus, the device achieves tonal expression by combining sub-fields having different lengths of the prolonged discharge period.

[0030] According to the present invention, no specification is made as to the particular arrangement of sub-fields within a field. Any arrangement of sub-fields within a field may be accepted as far as it is compatible with the inventive method for activating an image display panel.

[0031] Next, a method for arranging pixels in each field according to the present invention will be described with reference to Fig. 4.

[0032] Fig. 4(a) shows the arrangement of pixels for the first field while Fig. 4(b) the arrangement of pixels for the second field. For the two fields, the structure of panel remains the same, but combination of triads of display cells each constituting a pixel is different

between the two fields. Fig. 4(c) shows image signals responsible for the reproduction of a desired image. A pixel X1 shown in Fig. 4(a) is the pixel responsible for the production of a signal pixel S1 shown in Fig. 4(c), while a pixel X2 shown in Fig. 4(b) is the pixel responsible for production of a signal pixel S2 shown in Fig. 4(c). In the same manner, pixels of the first field arranged as shown in Fig. 4(a) are utilized to serve as signals for odd-numbered columnar lines shown in Fig. 4(c) while pixels of the second field arranged as shown in Fig. 4(b) are utilized to serve as signals for even-numbered columnar lines shown in Fig. 4(c). Namely, according to the display activation method of the invention, signals for odd-number columnar lines and signals for even-numbered columnar lines are utilized alternately for display. During this operation, the combination of red (R), blue (B), and green (G) cells constituting a pixel is made different between the first and second fields.

[0033] In the figure, the center of each pixel (closed circle) corresponds to the center of the corresponding display signal pixel. The distance between the center of a pixel of the first field and the center of a paired pixel of the second field should remain constant. To achieve this, it is known that the following relationship must be maintained between the widths of display cells Wb, Wg, and Wr.

[0034] Of the triad of red, blue and green cells constituting a pixel, the following relationship must be

maintained between the cell (Wb in this particular example) having the largest width and the remaining cells (Wr, Wg in this particular example) having the smaller widths: Wb = Wr + Wg. Then, the shift between pixel X1 of the first field and corresponding pixel X2 of the second field will equal to the pitch Ws of a corresponding display signal pixel. Namely, since it is possible for the signal pixel S1 and the succeeding signal pixel S2 shown in Fig. 4(c) to have the same width, it also becomes possible for the display panel to present a natural image. On the contrary, if this condition were not satisfied, that is, the width of display signal pixel S1 were different from the width of succeeding display signal pixel S2, the display panel would present an unnatural image.

[0035] For a pixel to have a pitch in the row direction which is equal to a pitch in the columnar direction, it is only necessary for the width of the pixel, that is, the summed width (Wx = Wb + Wr + Wg) of the triad of red, blue and green cells of the pixel in the row direction to have the following relationship with the length Hx of the pixel in the columnar direction: Wx = 2 x Hx.

[0036] Fig. 5 shows how an image is reproduced on the display panel where pixels are arranged as shown in Figs. 3 and 4. Fig. 5(a) represents a high resolution image to be desired. Fig. 5(e) represents a display of the same image on a panel having resolutions half those of the display panel of Fig. 5(a) in the columnar direction as well as in the row direction. Figs. 5(b), 5(c) and 5(d) represent

images displayed on an inventive display panel which comprises pixels each having a rectangular form whose width in the row direction (i.e., the width defined by adjacent barriers 8 cited with respect to the plasma display panel shown in Fig. 1) is the same with that of a conventional display panel and whose length in the columnar direction is half the width.

[0037] Fig. 5(b) represents signals on odd-numbered lines of a first field of the display shown in Fig. 5(a). Fig. 5(c) represents signals on even-numbered lines of a second field of the display shown in Fig. 5(a). Between the two fields, pixels on a line and pixels on an adjacent line are separated from one another by one pixel in terms of the pixels arranged on the display shown in Fig. 5(a). Therefore, when a display shown in Fig. 5(b) and a display shown in Fig. 5(c) are repeated alternately, pixels that are activated only in the display shown in Fig. 5(b) or Fig. 5(c) will have a brightness half that of common pixels that are activated in the two fields. Thus, the combination of the first and second field displays will give a display as shown in Fig. 5(d). When this display is compared with the display shown in Fig. 5(e), it is obviously possible for the former to present an image having a higher resolution, despite that the pixels of the two displays have the same width in the row direction.

[0038] Fig. 6 shows various kinds of pixel arrangements to compare the sizes of the cells constituting each pixel. Fig. 6(b) shows the conventional arrangement of pixels

where for each triad of pixel, the blue (B), green (G), and red (R) cells have different widths. If the three cells are allowed to have the same width, the green (G) and red (R) cells will be able to have a little larger width than is shown in the figure. Fig. 6(a) shows the inventive arrangement of pixels where for each triad of pixel, the display cells have the same widths with those of corresponding cells in the conventional arrangement shown in Fig. 6(b), whereas they have lengths equal to half the lengths of corresponding cells of the conventional arrangement. Therefore, with the inventive arrangement of pixels, although each cell has a length equal to half the length of a corresponding of the conventional arrangement, each cell has the same width with that of a corresponding cell of the conventional arrangement, and thus the interval between adjacent barriers is not narrowed, and thus loss due to adsorption of charged particles to adjacent barrier walls can be avoided. Fig. 6(c) shows the arrangement of pixels which will be obtained if the resolution given by the inventive display shown in Fig. 6(a) is reproduced by a display which maintains the conventional arrangement of pixels. For a conventional display to have the same resolution with that of the inventive display, obviously each cell must have a very narrowed width.

[0039] By adopting the arrangement of pixels and method for activating those pixels as described above, the display will be able to present a high resolution image without reducing the size of individual display cells, and thus to

reproduce a more natural image.

[0040] The inventive display method is based on interlaced scanning as does the method disclosed in Japanese Patent No. 2801893 cited above. However, although the method disclosed in the cited reference gives a display where, when one line is activated, adjacent lines are quiescent, according to the inventive method, all display cells are turned on during scanning which makes the display brighter.

[0041] Description has been given above in relation to an AC type plasma display panel. Obviously, the invention can be applied to any kinds of image display panels including DC type plasma display panels, field emission displays, liquid crystal displays, plasma addressing liquid crystal displays, etc. Namely, for any given display panel, as long as improvement of the resolution of an image on display is hampered by the limited narrowing of individual pixels, it will be possible by adopting the inventive method to circumvent the obstacle and provide an image display panel where the display of an image having a higher resolution is ensured.

[0042] In the particular examples shown in Figs. 4(a) and 4(b) and Fig. 6(a), the blue (B) cell is allowed to have the largest width. However, the other kinds of cells may have the largest width. In the particular example shown in Fig. 4(a), the green (G) cell is allowed to have the same area with that of the red (R) cell. However, it is not necessary for the two cells to have the same area. The absolute requirement for the widths of a triad of blue (B),

red (R) and green (G) cells only lies in that the area of the largest cell is equal to the summed area of the remaining two cells. Obviously, the sequential order of blue (B), green (G) and red (R) cells within a triad is not limited to any specific one but may be chosen arbitrarily.

[0043] In the above embodiment, the same phosphor cells are arranged one after another in the columnar direction; each pixel has a rectangular form where its parallel-to-row length is two times as large as its parallel-to-column length; and first fields consisting of odd-numbered row lines and second fields consisting of even-numbered row lines are repeated alternately. The above description still holds even when the row arrangement is exchanged for the column arrangement, that is, the feature of the invention is still applicable to a display where the row arrangement and the columnar arrangement are exchanged for each other. Namely, even when the same phosphor cells are arranged side by side in the row direction, each pixel has a rectangular shape where its parallel-to-column length is two times as large as its parallel-to-row length, and first fields consisting of odd-numbered column lines and second fields consisting of even-numbered column lines are repeated alternately, the feature of the invention is still ensured.

[0044]

[Advantages] As described above, according to the inventive display panel, each triad of three phosphor cells, i.e., red, blue and green cells are arranged side by side in the

row direction; each pixel has a rectangular form whose parallel-to-row length is two times as large as the length of a signal pixel to be displayed; one frame is divided into two fields, one field consisting of odd-numbered row lines and the other field of even-numbered row lines such that combination of display cells (red, blue, green) within each pixel is allowed to change between the two fields which makes it possible to reduce the area of each cell. This arrangement makes it possible to present an image having a high resolution without encroaching on the image reproduction efficiency, and complicating the fabrication process. Through this arrangement, it is also possible to reproduce a more natural image by making the widest cell within a pixel have an area equal to the summed area of the remaining two cells.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 is a perspective view of a plasma display panel representing an embodiment of the invention.

[Fig. 2] Fig. 2 is a top view of a plasma display panel representing an embodiment of the invention viewed from the viewer's side.

[Fig. 3] Fig. 3 illustrates a method for activating pixels to give a display according to the invention.

[Fig. 4] Fig. 4(a) shows the composition of a pixel on a row line belonging to a first field of a display activated according to the inventive method. Fig. 4(b) shows the composition of a pixel on a row line belonging to a second field of the display activated according to the inventive

method. Fig. 4(c) shows display signals produced by the inventive activation method.

[Fig. 5] Fig. 5(a) shows display signals of an exemplary display produced by the inventive method. Fig. 5(b) shows an image displayed by the pixels in the first field according to the inventive method. Fig. 5(c) shows an image displayed by the pixels in the second field according to the inventive method. Fig. 5(d) shows a synthetic image obtained by combining the images displayed by the pixels of the first and second fields. Fig. 5(e) shows an image displayed on a conventional panel in Fig (a)

[Fig. 6] Fig. 6(a) shows the array of cells arranged according to the inventive method. Fig. 6(b) shows the array of cells arranged according to the conventional method. Fig. 6(c) shows the array of cells which should be arranged according to the conventional method, if it is required for a conventional panel to attain the same resolution that is provided by the inventive method.

[Fig. 7] Fig. 7 shows exemplary arrangements of cells observed in conventional display panels.

[Reference Numerals]

1: Plasma display panel

2: Front substrate

3: Rear substrate

4: Scanning electrode

5: Holding electrode

4a, 5a: Metal bus electrode

4b, 5b: Transparent electrode

6: Dielectric layer

7: Protective layer

8: Barrier

9: Phosphor layer

10: Second dielectric layer

11: Write electrode

X1, X2: Display pixel

S1, S2: Pixel of display signal

Wx: Parallel-to-row length or pitch of pixel

Hx: Parallel-to-column length or pitch of pixel

Figs. 1-2

Fig. 3

(1) Initialization/address period, (3) Prolonged discharge period, (4) 1st field (odd-numbered row line display period), (5) 2nd field (even-numbered row line display period), (6) 1st subfield, (7) 2nd subfield, (8) 3rd subfield, (9) 4th subfield, (10) 5th subfield, (11) Time

Fig. 4

(1) Pixel X1

Fig. 5

(a) Image by display signals

odd-numbered row lines (displayed by 1st field)

even-numbered row lines (displayed by 2nd field)

(b) Image represented by 1st field

(c) Image represented by 2nd field

(d) Synthetic image

(e) Image on a conventional panel activated by a conventional method